# Chapter 4
# Weapons, Munitions, and Fire Control Equipment

## Section I
## Effects of Cold Weather

### CLIMATIC CONDITIONS

Severe conditions can interfere with the proper functioning of weapons, ammunition, and fire control equipment. Knowledge of these effects can minimize their impact on mission accomplishment.

#### Cold-Dry Conditions

Cold-dry weather causes sluggish motion and increased stress on moving parts lubricated by products manufactured for temperate climates. Rubberized parts and surfaces, as well as painted surfaces, are more likely to crack and break.

#### Condensation

Humidity and cold air combine to form condensation when temperatures change rapidly. Under extremely cold conditions, condensation will cause icing and corrosion of machined surfaces, especially in the bores of weapons. A combination of body warmth and breathing may cloud the optics of sights and fire control mechanisms.

#### Frozen Surfaces

Flat trajectory weapons, such as tank guns, may cause the vehicle chassis to move away from the direction of fire on frozen surfaces. Emplacement of mortar baseplates and howitzer spades is difficult and time-consuming. Weapons firing from frozen surfaces can damage the systems themselves and degrade accuracy.

#### Snow and Ice

Exposed gears and racks (i.e., elevating arc, traversing rack, and pinions)

can collect snow and ice in sufficient amounts to impede movement. Snow and ice can also contaminate lubricants and ammunition.

**Visibility**

Long periods of darkness, blowing snow, and ice fog greatly limit visibility. Ice fog, caused when water vapor from a muzzle blast crystallizes (usually around -30°F or lower), can hang over the weapon and follow the path of the projectile. In still air, the ice fog lingers, hindering accurate second-round engagement. Ice fog can also serve as a target acquisition aid for enemy gunners. Rain, snow, clouds, and fog also limit the effectiveness of lasers.

**Magnetic Conditions**

The farther north one travels, the more care one must take with magnetic instruments. These instruments are affected by increasing declination changes and by Aurora Borealis.

**WEAPONS FUNCTIONING**

The following problems or conditions affect the operation of weapons:

- The increased viscosity of hydraulic or recoil fluids, caused by lower temperatures, offers greater resistance to motion. This results in stiffness of operation and shortening of the recoil cycle.

- Over-lubricating in cold weather may cause parts to bind, resulting in misfires.

- Handwheels on both elevating and traversing mechanisms require greater effort.

- Gascheck pads fail to seal perfectly and deteriorate rapidly. Scoring of the gascheck seat is possible.

- Cable insulation, if not arctic-type, may fail when doubled or straightened.

- Frozen hand brakes on towed weapons may be difficult to release, and attempts to move weapons without thawing may cause serious damage.

- Equalizing bars and travel locks of

towed weapons must be covered or wrapped before towing over snow-covered terrain. The wrapping should be replaced, if wet, to prevent freezing of both the wrapper and the protected mechanism.

- In cross-country operations, a prime mover with the same tread/track width as the weapon should be used to ensure tracking.

- Firing lanyards must be kept dry and covered to prevent freezing and breakage.

## Section II
## Lubrication in Cold Weather

### SPECIAL CONSIDERATIONS

It is imperative to keep machined surfaces clean and not over-lubricated. Lack of lubrication may cause rust to form on uncoated surfaces and create friction between rubbing surfaces. These conditions impede the functioning of the weapon. On the other hand, use of too much lubricant may impede the motion of the components or result in a buildup of solidified oil or grease.

The proper type and grade of lubricant must be used (Appendix B). Certain lubricants are selected for different temperature ranges because the physical properties of oils and greases vary with changing temperatures, usually becoming thick and viscous as the temperature drops. Thus, a lubricant designed for use at room temperature may become thick and unsatisfactory at sub-zero temperatures, or may become too thin to lubricate metal surfaces at high temperatures. Lubricants can also be selected because they are environmentally preferable.

### PROCEDURES FOR LUBRICATING WEAPONS

DS maintenance facilities winterize artillery weapons. Prior to issue, recoil mechanisms must be modified to ensure satisfactory operations to -65°F. Often, preparation of artillery requires special winterization of component parts. Follow instructions in LOs and TMs with the following changes in emphasis:

- Lubricants must be applied in smaller quantities more frequently. For example, a biweekly interval may be changed to weekly.

- Grease, wide temperature range (WTR), is recommended for use on artillery at all temperature ranges. Use WTR whenever special lubricating grease is specified. It displays superior lubricating qualities at extremely low temperatures.

- Petroleum-based hydraulic fluid (OHT) or FRH, as specified, should be used in hydraulic gears as well as in hydrospring and hydropneumatic recoil mechanisms. These products replace special-recoil and light-recoil oil for low-temperature operation. The changeover to petroleum-based hydraulic oil in recoil mechanisms is accomplished as follows:

  – Drain existing recoil oil. Raise, lower, and rotate the mechanism to aid in removing the original oil.

  – Fill recoil mechanism with OHT or FRH as specified. Establish oil reserve and install mechanisms on carriage or mount.

**CAUTION**
**EXTREME CARE MUST BE TAKEN TO ENSURE THAT MOISTURE, SNOW, ICE, AND**

**DIRT ARE NOT INTRODUCED INTO THE MECHANISM DURING THE CHANGEOVER PROCESS.**

Replace preservative lubricating oil, bore cleaner, or normal lubricating oil with cleaner lubricant and preservative (CLP) in cold temperatures. The exception is in the bores of mortars where CR and lubricating oil, weapons (LAW) should be used. To put a temporary finish on corroded exterior metal surfaces, use solid film lubricant (SFL), except on moving parts and stocks.

Replace CLP with LAW when anticipating operations at temperatures below -10°F. Below -10°F, CLP fails to provide proper lubrication to individual and crew-served weapons.

Follow all federal, state, and local laws and regulations and unit SOPs regarding the storage, transportation, and final disposition of all greases, oils, and solvents. Spills of such materials must be promptly cleaned up and reported via the chain of command IAW the unit spill-plan.

## Section III
## Operation and Maintenance of Weapons

### USE OF COVERS

Whenever materiel is to remain idle for a time, it should be covered for protection. Wind will drive snow under the covers unless snugly and securely fastened.

To prevent materiel from freezing to the ground, prepare a footing of planks, brush, or matting. Straw or hay may also be used for this purpose. Pedestals, rails, outriggers, skids, generating units, and points of tripods that go into the ground can be covered with grease to prevent them from freezing to the ground. Seal exposed openings to ensure that parts are free of ice or snow. Keep the ends of canvas tarpaulins off the ground to prevent them from freezing to the ground.

### DEALING WITH CONDENSATION

When weapons, sighting and fire control materiel, parts, or assemblies are brought indoors after having been outside at low temperatures, water vapor in the warm air condenses on the cold parts. The condensation causes corrosion if not immediately removed.

If the materiel is operated indoors while moisture is present, the moisture forms an emulsion with the lubricants. This requires removing all the grease and cleaning and lubricating the materiel. If the materiel is taken outside into low temperatures before the condensed moisture is removed or has evaporated, the parts may freeze and become inoperable.

It is better to leave fire control materiel outdoors, but covered, to protect it from the snow. Snow-tight lockers or sealed containers issued with the materiel maintained at outdoor temperatures are recommended for storing binoculars, telescopes, and other fire control equipment.

If it is necessary to bring instruments or other materiel from low outdoor temperatures into higher room temperatures, use *anticondensation* containers to prevent condensation of moisture on the instruments. The containers can be specially made boxes, covered cans, or other fairly airtight containers with heat-conducting walls. Keep containers outside until time to bring an instrument indoors. Put instruments into a container,

closing it tightly. Then bring the container indoors and let stand until its inner temperature has had time to equal the room's temperature. A stove can hasten a container's warmup.

If air in a container is cold and dry, it expands and presses outward when it is heated. Therefore, no warm, humid air from the room can come in contact with instruments and cause condensation. When the instruments and inner container reach room temperature, the instruments can be removed with no danger of condensation.

If *anticondensation* containers are not available, wrap materiel in blankets or similar material before it is brought into a heated enclosure. This will retard or impede the condensation process just described.

**CREWMEMBER CONSIDERATIONS**

When using sighting and fire control materiel at sub-zero temperatures, operators' hands need protection. Gloves with liners, trigger-finger shells with liners, or arctic mitten sets should be worn.

Gloves are appropriate around 0°F and higher, but the arctic mitten set or the trigger-finger mitten should be worn at colder temperatures. Since mechanical motion of most knobs and levers will be less free than at milder temperatures, adjustments will at first seem awkward and difficult to operators used to working with bare hands. Awkwardness and difficulties will lessen with practice.

Because many knobs and handwheels are difficult to manipulate while wearing arctic mittens, it may be necessary for operators to wear anticontact gloves. If anticontact gloves are not available and it is necessary to use bare hands, the discomfort of contact with cold metal can be lessened by wrapping adhesive tape around the knobs and handwheels.

Although personnel should go indoors as often as possible, they should avoid rapid warming over stoves or other heating units.

**EXERCISING**

Weapons should be elevated and traversed at intervals that ensure operation when the weapon is needed. The rammer should be cycled several times before ramming rounds and at intervals to ensure proper operation. The recoil mechanism can be moved only a short distance under sub-zero temperatures. Always exercise the recoil mechanism before firing to make sure recoil parts are not iced up.

**DAILY CARE**

Inspect materiel daily. Whenever possible, use gun covers and shelters for protection. The following points are important in providing maximum protection for weapons.

- Keep all parts thoroughly clean.
- Clean and oil the breech mechanism daily.
- Lubricate sparingly.
- Do not let snow and ice collect on moving parts.

**TRAVEL**

Before starting a road march, make a thorough inspection and provide as much protection as possible for all parts, as follows:

- Ensure all covers are properly installed and securely lashed. If covers are inadequate, improvise by using canvas, burlap, or any other suitable or available material.
- Perform all preventive maintenance operations and precautions prescribed in manuals pertinent to the materiel.

- During travel, take more than usual driving care because suspension assemblies become stiff in cold weather and break easily. Refer to FM 31-70 for driver precautions.

**EMPLACEMENT**

The selection and preparation of weapon sites in ice and snow require more consideration than when the weapon is to be emplaced on bare, level ground. If ice and snow are melting, select a site that will not become mired or flooded.

Prepare a platform of pierced steel planking (materiel used for improvised airstrips), boards, brush, and matting at the spot chosen for the emplacement. Push or tow the weapon onto the platform so that the platform is beneath the wheels and firing jack float (or auxiliary firing jack platform). Prepare recoil pits and spade positions. When an artillery piece is to be fired from a soft, spongy surface, a deeper recoil pit must be dug to prepare for the sinking of the weapon during firing.

Coat with waste lubricant all metal parts of the trails and spades coming in contact with snow or frozen ground. This prevents freezing in place and facilitates subsequent shifting of the trails. Waste lubricants may be used on any parts, except rubber, that touch the ground.

Special, large frost-spades or spade attachments may be improvised to suit local conditions. In hard, frozen ground, protect trails against the tendency to buckle and break by placing logs between the spades and ground. This provides added resilience.

The firing jack and its locking lug may become covered with ice and frozen mud in transit. Ice and mud must be entirely removed before the jack can be completely lowered and locked in firing position. Swab the exterior of the jack with GMD and see that all seals are tight and serviceable.

**CAUTION**
**DO NOT PACK GREASE IN THE JACK HOUSING.**

Aiming posts should not be driven into frozen ground. A hole should first be made with a pick or crowbar. Manufacturing of a stand that rests on top of frozen ground or ice is an approved method of supporting the aiming post for use in weapon alignment. An aiming post is self-supporting in about 26 inches of packed snow. Use of the aiming light, equipped with dry-cell batteries, is possible only for short periods. Batteries are kept warm and serviceable by carrying them or the light next to the body. Use alkaline batteries rather than carbon batteries.

**BREECH AND FIRING MECHANISMS**

A frozen breechblock usually cannot be forced to move. If ice prevents opening or closing the breech, use a portable heater for thawing. Remove the breechblock and dry it thoroughly. Keep the breech mechanism tightly covered.

Clean all parts daily, except gascheck pads, with dry-cleaning solvent or mineral spirits paint thinner and lubricate as prescribed in Section II of this chapter.

**CAUTION**
**DO NOT USE DRY-CLEANING SOLVENT, MINERAL SPIRITS PAINT THINNER, OR RIFLE-BORE CLEANER ON GASCHECK PAD. SIMPLY WIPE IT CLEAN AND PERMIT IT TO DRY; DO NOT LUBRICATE.**

Frozen manual and electric firing linkages renders a weapon useless. Frozen solenoids do not close contacts for electric firing.

After firing, the breech and firing mechanisms of weapons using fixed and semifixed ammunition should be disassembled, cleaned with dry-cleaning solvent or mineral spirits paint thinner, dried, and oiled sparingly. Mechanisms on weapons using separate loading ammunition should be disassembled. All parts, except gascheck pad and electrical ring mechanisms, should be cleaned with rifle-bore cleaner (MIL-C-372), dried, and oiled sparingly.

The asbestos covering of Gerdom-type gascheck pads becomes very brittle in cold. If the asbestos has cracked and the wire mesh is exposed, it causes the gascheck seat to become scored and impossible to repair. A new pad is required if wire is exposed.

The breech and firing mechanisms must be completely disassembled for cleaning and lubrication. Clean all parts, and apply a light film of LAW, by wiping the surfaces with a clean cloth that has been wet with oil and thoroughly wrung out. Excessive lubrication of the firing mechanism can cause misfires.

**BORES**

In severely cold weather, bores are susceptable to increased impact loads and may crack due to metal brittleness. Constant inspection and care is required to prevent failure.

**Before Firing**

Before firing, wipe the bore and chamber dry. Clean and coat bore evacuator, muzzle brake, blast deflector, and counterweight as prescribed in the TM.

**During Firing**

At every opportunity during firing, inspect the muzzle end of the tube, bore evacuator, muzzle brake, blast deflector, counterweight (as applicable), and the breech ring. Examine for development of cracks.

In severe cold, metal becomes brittle and more susceptible to failure under impact loads that a weapon receives when fired. Cracks generally indicate materiel deficiencies or metal fatigue. However, tool marks may be mistaken for cracks, and some cracks are not always visible. Cease firing when cracks develop; notify GS or DS maintenance support.

**After firing**

CLP can be used as a cold weather bore cleaner and preservative down to -10°F. Below that temperature, LAW is preferred. If it is not available, clean the bore evacuator, muzzle brake, bore, and chamber with rifle-bore cleaner while the weapon is still warm, but not too hot to be touched with bare hands. For temperatures below -20°F, warm the solvent cleaning compound before using so that it is thin enough to use effectively. All cleaner residue must be wiped off. Any residue remaining in the tube will freeze and make firing dangerous. Complete the second and third cleaning of the bore and chamber after firing, as prescribed for mild and moderate conditions in the pertinent LOs and TMs.

**Daily care**

In below-freezing temperatures, wipe the bore dry every day and apply a light film of LAW.

**RECOIL MECHANISMS**

All hydropneumatic and hydrospring recoil mechanisms will be filled with hydraulic

fluid (OHT) or FRH as specified. Keep close check on length of recoil during extreme cold weather firing. Take precautions to prevent snow, water, or dirt from entering the reservoir.

Hydropneumatic mechanisms are affected by reduction of gas pressure at low temperatures, as well as thickening of recoil oil.

**WARNING**

**THE POSSIBILITY OF INJURY TO PERSONNEL OR DAMAGE TO MATERIEL IS PRESENT WHEN ADJUSTING GAS PRESSURE IN THE RECUPERATOR. THEREFORE, ADJUSTING THE GAS PRESSURE IN THE RECUPERATOR IS A FUNCTION OF DS OR GS MAINTENANCE SUPPORT. THE PERSON IN CHARGE OF THE UNIT IS RESPONSIBLE FOR HAVING THE GAS PRESSURE IN THE RECUPERATOR ADJUSTED TO CORRESPOND WITH THE EXISTING TEMPERATURE CONDITIONS.**

Care of recoil mechanisms is nearly the same during cold weather as it is under normal conditions. Using units must maintain a careful check on recoil mechanisms. On self-propelled guns, the recoil fluid surrounds the gun tube and is subject to a larger range of temperature changes and subsequent pressure variations. These pressure changes must be watched and adjustments made to keep within the required pressure range.

Condensation and ice tend to form on a weapon during freezing temperatures. Parts such as recoil and counterrecoil rods and variable recoil cams must be wiped dry and lubricated lightly with LAW every day.

While the oil is cold, the cycle of recoil may take longer than usual. As further firing is conducted, the action gradually warms the recoil oil and thins it so that normal cycle time is obtained. A sticking recoil mechanism may result in severe damage to the weapon when it is fired; therefore:

- Exercise the recoil mechanism frequently. Intervals of exercise depend on the existing temperature, becoming more frequent as the temperature decreases.

- To ensure that recoil parts are free from frost binding, exercise the recoil mechanism prior to firing whenever the weapon is subjected to freezing rain, windblown snow and ice, or fluctuating temperatures.

- Refer to pertinent weapon TMs for methods of exercising the recoil mechanism.

If the recoil mechanism is equipped with an adjustable respirator, it should be opened as far as possible when commencing fire in low temperatures.

**CAUTION**

**EXTREME CAUTION MUST BE EXERCISED TO KEEP THE PARTS OF A RESPIRATOR FREE OF SNOW AND ICE.**

Check the oil level of the recoil mechanism at the intervals prescribed in the applicable TM and whenever there is a marked change in temperature. Inspect all partially filled hydraulic fluid containers to avoid the possibility of using contaminated fluid. Discard all contaminated fluid.

**RECOIL SLIDES**

Friction between recoil slides and guides absorbs an appreciable amount of recoil energy. Thickened or congealed lubricants increase friction, shorten recoil, and retard counterrecoil. Snow and condensation on the slides contaminate the lubricant and destroy its lubricating properties. To ensure proper recoil and counterrecoil action, remove the old lubricant from the slides every day by using dry-cleaning solvent or mineral spirits paint thinner. Smooth all surfaces and lubricate lightly.

When exposed to windblown snow and ice, dry operation of the recoil slides and other exposed metal working surfaces may be necessary. Lubrication, however, should be applied during standby periods. Guns treated with dry lubricant need only be kept clean and free of ice and snow.

**EQUILIBRATORS**

Clean, dry, and lightly lubricate the piston rods or tubes of equilibrators every day during cold weather operations to prevent icing. Carefully examine and remove any corrosion or marring of the smooth, unpainted surfaces with crocus cloth.

Lubricate the designated equilibrator parts with WTR at the intervals prescribed in the LOs and the TMs. Too much lubricant at cold temperatures may cause the gun to stay out of battery after firing. This is compounded if the pressure in the equilibrators has not been adjusted for cold temperatures. Wash the bearing thoroughly with dry-cleaning solvent or mineral spirits paint thinner, dry thoroughly, and lubricate. It is necessary to remove the equilibrator in order to wash bearings properly.

After the daily cleaning and drying of the equilibrator piston rod or tube, protect the smooth unpainted surfaces against corrosion by applying a very light film of LAW. Wipe the metal surfaces with a clean cloth that has been wet with oil and thoroughly wrung out.

Adjust the nitrogen pressure of pneumatic-type equilibrators to provide proper equalizing action. If the equilibrator is equipped with a low-temperature control, make the adjustment IAW the temperature scale provided.

**CAUTION**

**THE NEWER HOWITZERS USE NITROGEN TO PRESSURIZE THE EQUILIBRATORS. SINCE TEMPERATURES FLUCTUATE, EQUILIBRATOR PRESSURES REQUIRE FREQUENT CHECKS (SEE OPERATOR'S TM). IF A COLD HOWITZER IS BROUGHT INTO A WARM SHELTER, PRESSURES WILL INCREASE DRAMATICALLY, AND IF THE ELEVATION HANDWHEEL IS THEN RELEASED, THE HOWITZER WILL ELEVATE RAPIDLY, POSSIBLY CAUSING INJURY TO THE USER AND DAMAGE TO THE EQUIPMENT OR THE BUILDING.**

**ELEVATING AND TRAVERSING MECHANISMS**

Snow and ice particles frequently collect on the arcs and pinions and cake under pressure of the gears. Since this interferes with elevating and traversing, remove the snow by brushing vigorously with a stiff bristle or wire brush.

After snow is removed, the parts should be left dry for firing or swabbed with a light application of LAW to permit smooth and easy operation and prevent rusting.

**CRADLE, SLEIGH, CARRIAGE, AND MOUNT**

Disassemble the mechanism as required to obtain access to all parts. Thoroughly clean all parts, ensuring that all rust, dirt, and old lubricant are removed before applying prescribed lubricant. Lubricate sparingly as prescribed in LOs and TMs.

## Section IV
## Direct Fire Weapons

### ARMOR VEHICLE MAIN ARMAMENT

Ice fog forms when the weapon is fired. Lubrication and breakage problems are not as frequent as those for artillery pieces because most of the weapon's working parts are enclosed in a warm turret. Temperature changes can have major effects on the ammunition.

Propellants tend to burn slower in the cold, reducing the velocity of projectiles. Therefore, the firing data for temperate climates cannot be used, and the weapon must be zeroed for the temperature in which it is being fired.

Ammunition stored inside the turret will be warm and have the same general ballistic characteristics as ammunition fired in temperate climates. The weapon is generally zeroed with this warm ammunition. Other ammunition is stored outside the tank where the temperature is extremely cold. When this ammunition is fired, the powder burns slowly and has completely different ballistic characteristics, rendering the initial zero useless. If possible, the ammunition brought in from the outside should be heated in the turret before firing. In a combat situation, this is not practical because the ammunition may have to be used immediately. The gunner must have his own data for cold ammunition or be ready to hastily re-zero the weapon. Either way, he will have to make a sight adjustment.

## Section V
## Indirect Fire Weapons

### FIELD ARTILLERY

Most of the problems and precautions involving operations and maintenance of artillery pieces are the same as for weapons in general. However, consider the following aspects of artillery operations in cold regions:

- Recoil oil indicators may show low readings when pieces are cold. Firing a few rounds warms the oil and raises the indicator level.

- Howitzer bores require more frequent cleaning at low temperatures as a result of residue left from incomplete burning of propellant charges. However, bore cleaner can freeze in the chamber and prevent loading a round. CLP is an authorized alternative to bore cleaner, and is effective down to -10°F. Below that temperature, LAW is preferred.

- Special care is required for gascheck pads. A dry cloth is enough to clean the gascheck pad and electrical ring mechanism.

- Adjustable recoil respirators should be left open as far as possible before firing the first round in cold weather. Respirators should be kept clear of ice and snow.

- Congealed lubricants and grit hinder movement of elevation and traversing handwheels.

- Some towed weapons, like the M198 howitzer, use year-round lubricants, even in cold weather.

- Only the ammunition required immediately should be prepared for firing to prevent snow and ice from contributing to wet propellants.

- On frozen surfaces, stability and accuracy diminish at lower firing elevations.

The choices for firing surfaces should be muskeg, gravel, frozen ground, and ice, in that order. Even with cushioning, firing from ice is one of the greatest causes of damage to artillery pieces in cold regions. Waste lubricants on trails and spades in snow and ice can prevent freezing to the ground. So can laying tree boughs or straw under trails and spades. Such cushions can also be placed under firing jacks and firing platforms.

- Crews wearing the bulky cold region uniform, especially handwear, must practice drills and maintenance to gain proficiency in cold weather cannoneering.

**MORTARS**

The mortar's baseplate must be solidly positioned to prevent sliding. It may be necessary to dig into the ground to accomplish this. Frozen ground has no resiliency, and the baseplate and other bracing parts of the weapon absorb the entire shock of firing. When the weapon is emplaced on frozen ground, the cold makes the metal brittle. The combination of brittle metal and the tremendous shock that the baseplate receives when a round is fired may cause the baseplate to crack.

Due to the tremendous shock and the extra weight of the sight, the mount will break if the baseplate is not solidly positioned. Remove the sight each time before firing until the baseplate is settled.

One field expedient that reduces the possibility of a cracked baseplate is to place a brush matting under the baseplate. The matting should be thick enough to act as a shock absorber, but not so thick as to cause the baseplate to bounce out of its position. Snowshoes under bipods will prevent them from sinking in the snow.

Another method of positioning is to place bags of dry sand or snow beneath the baseplate. The sandbags provide the weapon with a solid, yet resilient, shock-absorbing base. The baseplate is best seated by firing at a quadrant elevation (QE) of 1,200 mils and a middle charge. If the baseplate must be seated in snow, the bottom should be coated with waste lubricant.

Mortar baseplates should not be seated in frozen surfaces using maximum or near maximum charges. Even when the baseplate appears to be properly seated, the crew can expect the mortar to shift to the rear, and even collapse, when firing at elevations below 900 mils.

An added problem is that mortars cannot be handled without touching bare metal, as can other infantry weapons with wooden or plastic handles and stocks. The crew must keep their gloves or mittens on and avoid touching the metal surface with bare flesh.

Mortars present practically no lubrication or ice fog problems. However, due to incomplete burning of propellants, the mortar tube should be dry-swabbed after every tenth round or after each fire-for-effect. At least a half-hour should be allowed before cleaning after the mortar is moved from a cold to a warm location.

**CAUTION**

**USE OF GLOVES THAT ARE NOT ANTICONTACT RESULTS IN A MORTAR SHELL NOT DROPPING PROPERLY DOWN THE TUBE, DAMAGING EQUIPMENT, AND CAUSING INJURY OR DEATH. THE WEARING OF BULKY OR LOOSE FITTING GLOVES MAY CAUSE THE GLOVE TO BECOME PINCHED BETWEEN THE ROUND AND THE BORE OF THE MORTAR TUBE AS THE ASSISTANT GUNNER FOLLOWS THROUGH IN DROPPING THE ROUND.**

Lubricate mortars M29A1 (81mm) and M30 (4.2 inch) sparingly and do not use PL (SP) below 0°F. Use LAW instead of GPL below 10°F as a lubricant and bore cleaner on

the newer 60mm, 81mm, and 120mm mortars. The bore should be kept dry, and lubricant kept away from the firing pin. All moving parts and the bore should be checked for snow and ice before firing. Never lubricate mortar shock absorbers.

NOTE: There is currently a restriction preventing CLP from being used in the bore of a mortar.

Mortar gunners and assistant gunners normally use the standing position to avoid cold ground. In this position, they must properly execute round-firing and be conscious of added noise problems inherent with firing the mortar in the cold, dry air. Ear protection is a must.

When seating the baseplate--

- Select a position with vegetation on the ground surface whenever possible. If you must set up the baseplate on snow, coat the bottom with waste oil to prevent freezing to ground surfaces.

- Use two men on the bipod when seating on ice or at high elevation (1,300 mils or higher).

- Train gunners to operate the mortar without breathing on the optics. Optical instruments should be kept sheltered but unheated when not in use, preferably in their cases. Doing this protects them against cold and shock.

- Boresight frequently.

- Practice using compensated sight picture (the rule rather than the exception), when firing from frozen surfaces.

- Ensure mortar crewmen do not remove anticontact gloves (CTA 50-900) when temperatures fall below -20°F. These gloves help prevent cold burns while still providing enough dexterity.

The new family of mortars and mortar rounds (with obturators) are very precise, indirect fire weapons systems. In fact, the systems are more precise than current mortar gunnery procedures. To improve gunnery, mortarmen should practice laying all fire control equipment to zero mils rather than within two mils. This is especially true in cold regions where the mortar can be laid equally as fast at zero mils as at two mils when wearing correct handwear. For best results, ammunition and mortars should be the same temperature.

## Section VI
## Antitank Wire-Guided Missiles/Rockets

### MISSILES

The principal difficulties with wire-guided missiles, such as the TOW and Dragon, are target acquisition and tracking.

Moisture condensing on the eyepiece can literally *blind* the fire control system. When a gunner initially tries to gain a sight picture, moisture from his breath and his body heat near the lens may cause condensation on the lens. To offset this phenomenon, use the protective mask with the winterization kit installed.

Extreme cold causes distortion for the AN/TAS-4A night sight when cold hits the heat rising from the vehicle engine on

mounted TOWs. Position the vehicle so the TOW is aiming away from the engine.

Depending on the direction of the wind, activation of the launch drive motors after initial firing creates some ice fog at -30°F and colder. This hinders the gunners' ability to track targets after firing, attempt second-round engagements, or acquire new targets.

An added burden for TOW units is the requirement to transport the TOW system in their ahkio (sled) groups in addition to cold region survival gear. This requires either more soldiers or a reduction of systems employed.

Wing nuts on the battery of the missile guidance set (MGS) freeze in place and then pop off when the battery is loaded. Prevent seized nuts by twisting each one before loading the battery.

Rubber eyeshields on optical and night sights freeze, collect ice, and crack, thereby leaving optics vulnerable to ice and snow. Snow and ice can also cause poor electrical connections on clamping surfaces on the traversing unit, sights, and missiles.

**ROCKETS**

Rockets and missiles generally operate satisfactorily in cold weather (0°F to -40°); however, consult the TMs applicable to a particular rocket or missile to determine exact firing limits. Information concerning extreme cold operating procedures for rocket and missile materiel can be found as follows:

- Antifreeze materials, fuels, hydraulic fluids, and lubricants - Chapter 1, Section IV.
- Heaters - Chapter 1, Section VI.
- Auxiliary equipment (air compressors, auxiliary engines, power take-offs) - Chapter 2, Section IV.
- Fire control materiel - Chapter 4, Section VII.

**CAUTION**
**ELECTRICALLY POWERED SYSTEMS ENCOUNTER DIFFICULTIES IN OBTAINING AN EFFECTIVE ELECTRICAL GROUND WHEN FIRING FROM FROZEN SURFACES. THIS MAY BE OVERCOME THROUGH TRAINING OR USE OF EXPEDIENT GROUNDING TECHNIQUES.**

## Section VII
## Field Artillery Missiles/Rockets

**MISSILES**

Missiles and rockets have minimum and maximum temperatures at which they can be fired. Most have this information printed on them. For others, consult each weapon's TM before firing them in extreme cold.

## Section VIII
## Air Defense Weapons

**MISSILES**

On the Chaparral system, proper cold-weather settings prevent poor air circulation, overheating, oil leakage, or failure to operate properly.

The oil pan baffle on the gas-powered main power unit (MPU) should be closed--or up--for temperatures that average 0°F or below. Secure the baffle with lockwire. The MPU's carburetor air inlet WINTER/SUMMER

valve must be full left for temperatures below 35°F. Number-one and number-two ducts on the MPU air duct must both be open in sub-zero weather, and both should be closed above 35°F. Number-one stays open and number-two is closed between 0° and 35°F.

Set the battery box WINTER/SUMMER valve on WINTER during battery warmup when the temperature is below 35°F. Keep it on that setting for 5 to 60 minutes, depending on the temperature. Battery heater warmup time is in TM 9-1425-2586-10. After battery warmup, switch the battery box valve to SUMMER position. Set the oil pump WINTER/SUMMER valve to WINTER when it is below 35°F.

**GUNS**

Cold weather precautions for air defense guns are similar to those for guns in direct fire roles.

## Section IX
## Ammunition and Munitions

**AMMUNITION**

Cold weather not only affects personnel and equipment but ammunition as well. Failure to understand the possible problems and how to prevent them can make a unit combat-ineffective.

**Large Caliber Ammunition**

Moisture and humidity can make life miserable for tank, artillery, and mortar crews. Icing can cause misfires, damage to the pieces, and injuries to crewmembers. While cold, dry conditions do not drastically alter the terminal effects of direct fire weapons, they dictate added training and planning for indirect systems. That is because range and burst effects drop off dramatically.

**Temperature Limitation**

Temperature limitations are not stamped on all individual items of ammunition. However, all temperature limitations are contained in the applicable TM 43-0001 (Series), Ammunition Data Sheets.

**CAUTION**

**WITH COLD ROUNDS IN A COLD TUBE, ACHIEVED RANGES FOR INDIRECT FIRE SYSTEMS MAY BE AS MUCH AS 20 PERCENT LESS AT A TEMPERATURE OF -40°F THAN THAT INDICATED IN THE TABULAR FIRING TABLES (FOUR ROUNDS FIRED OVER A PERIOD OF ONE TO THREE MINUTES WILL WARM THE TUBE).**

Snow-covered surfaces tend to diminish the blast effects of rounds with point detonating fuzes. At the firing point,

condensation on a round which freezes in the breech may lead to a misfire. Misfire procedures employed in temperate climates for a round stuck in a howitzer must be modified in cold regions. Pouring a solution high in antifreeze down the tube may be effective in forcing out a stuck round. Another technique involves the use of hydraulic fluid, which does not freeze during the process and acts like a penetrating oil to dislodge the stuck round.

**WARNING**
**DO NOT USE AMMUNITION AT AMBIENT TEMPERATURES BELOW THAT SPECIFIED ON THE AMMUNITION.**

**Combustible Cartridge Case Ammunition**

It may be difficult to remove the combustible cartridge case round from its fiber packing container. This is because a vacuum is formed in the container behind the cartridge when attempts are made to remove the rear portion of the container. Tapping a small hole in the metal end of the fiber container at the using unit level is **"UNAUTHORIZED"** due to the possibility of striking the primer**.**

Take care when handling the combustible cartridge case round to protect it from damage. The case can be cracked or broken by dropping or hitting it against the side of a vehicle.

Loaders may have difficulty removing the neoprene barrier bag when the cartridge is on the loading tray. If difficulty is encountered, try removing the bag while the cartridge is still partially in the rack.

Cold affects mortar ammunition the same way as other types of ammunition. Firing tables may be used provided the proper range corrections, based on cold weather conditions, are established through experience. Consult TM 43-0001-28 and applicable firing tables for charge restrictions at low temperatures.

The following guidelines apply to ammunition in a winter warfare environment:

- Due to incomplete burning of propellants, expect a decrease in achieved range versus the plotted range. This decrease may be as much as 10 percent at -10°F and 20 percent at -40°F.

- Keep ammunition and tube dry. Only open as many rounds as required for the current fire mission and use the tube cover provided.

- Swab the tube after every tenth round or after every fire-for-effect.

- When firing into snow, try to obtain an airburst. Snow decreases dramatically the effect of white phosphorous and fragmentation rounds.

- When firing into frozen surfaces, fuze delay frequently produces better

fragmentation in the form of a bounce airburst than a quick setting.

Table 4-1 shows expected results when firing into typical cold region terrain while using the M732 multioption fuze.

When firing at low temperatures, double misfire wait times due to the possibility of delayed ignition. The new 60mm and 81mm mortars employ a trigger mechanism that allows the firing pin to be recocked and fired. With these mortars, misfire times do not have to be increased.

**GRENADES**

Using hand grenades in cold conditions can present some unusual problems. Personnel wearing gloves or mittens must take added precautions.

**Hand Grenades**

The fragmentation effect of hand grenades in severe cold temperatures is diminished when detonated under snow. When throwing hand grenades during cold weather conditions, personnel wearing handgear must take the following precautions:

- Ensure handgear is completely dry. Handling of snow and ice may result in grenades freezing to the wet handgear.

| HEIGHT OF BURST IN FEET ABOVE GROUND SURFACE | | | |
|---|---|---|---|
| FUSE OPTION | EARTH | SNOW | LAKE ICE |
| NEAR SURFACE | 1-3 | 1-3 | 1-5 |
| PROXIMITY | 9-15 | 1-5 | 10-25 |
| SQ | 0 | 0 | 0 |
| DELAY | 0-3 | 0-3 | 0-3 |

**Table 4-1. Results of M732 multioption fuze**

- Hold grenades near the neck of the fuze to avoid slipping or turning of the grenades when safety pins are removed.

- Right-handed throwers rest the grenade safety lever between the first and second knuckles of the thumb to ensure a sensitive feeling of the safety lever. Left-handed throwers hold the lever with the thumb by holding the grenade upside down. This procedure provides ready access to the safety pin ring (Figure 4-1).

**MINES**

Mine warfare in cold regions demands special precautions to be successful. As little as six inches of snow can reduce the effects and detection of mines and unexploded ordnance (UXO). Emplacing and extracting mines in frozen ground becomes impossible in frozen surfaces.

The rapidity and amount of snowfall in a single night makes marking a minefield crucial for recovering them. This also affects the decision whether to booby-trap them and how. In deep snow, branches or crossed sticks placed under the mines provide a useful snowshoe effect. Otherwise, they may be

simply pushed deeper into the snow by the passage of the enemy rather than detonated. Care must be taken while emplacing mines when temperatures are changing, since recovery is difficult when mines are frozen to the ground.

Snow severely inhibits the family of scatterable mines (FASCAM). Besides the decreased blast effects, the self-orientation characteristic of the mines may not successfully complete the arming sequences and will self-destruct to prevent improper detonation of the mine. Also, the trip wires may not be ejected properly, thereby negating that capability.

**DEMOLITIONS**

Cold affects the ability to employ demolitions effectively. Handling becomes a partnership or team effort. FM 5-25 discourages the handling of demolitions while wearing gloves, but gloves are a must in cold regions. Special considerations must be made for the type of munitions and type of gloves worn. Thin leather gloves may provide some protection from the extreme cold and allow the dexterity required to manipulate the demolitions.

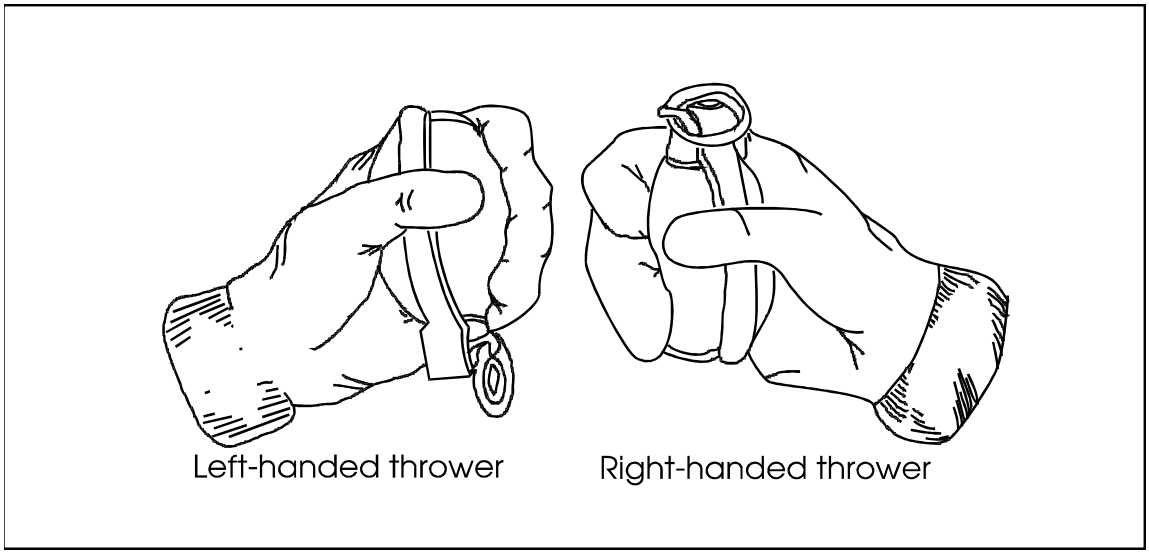


**Figure 4-1. Cold weather grenade procedures**

Plastic explosive, C-4, becomes very hard, making the insertion of an initiating device difficult unless done in a warm shelter prior to its use. For this reason, TNT is preferred because initiating device couplers are built into the blocks. Also, at temperatures of -40°F and colder, C-4 sometimes shatters from the explosion of its initiating device rather than detonating. Military dynamite or TNT blocks are excellent for use in cold regions for projects like digging hasty fighting or firing positions.

Shaped charges do not penetrate as far as indicated in FM 5-25 or TM 9-1375-213-12; as adjusted data are not readily available, experience must dictate their uses.

The detonation cord and time fuse become stiff in the cold. They do not tie as easily as in temperate zones, and break easily. Also, the time fuze tends to maintain its curl and break if uncurling is attempted, except inside warm shelter.

Condensation contributes to increased chance of misfire in the cold. Hangfire and misfire waiting times should be doubled in cold regions. Taping over ends of detonation cord, caps, and igniter may prevent condensation contamination of the firing system.

Static electricity easily develops under cold, dry conditions. Because of this, nonelectrical detonation techniques are preferred over electrical ones.

## Section X
## Fire Control Equipment

### PRECAUTIONS

Sighting and fire control materiel operate satisfactorily at sub-zero temperatures if properly winterized and if certain adjustments are made.

When the LO for fire control materiel specifies oil, lubricate sparingly with instrument lubricating oil (OAI). In extreme cold weather operations, a thin film of oil is more effective for lubricating fire control mechanisms than a heavy application. It also affords adequate corrosion protection. When the LO for fire control materiel specifies grease, lubricate sparingly with aircraft and instrument grease (GIA).

Ordnance maintenance of fire control equipment in severe cold weather is difficult, especially where shop facilities are scarce. Thoroughly inspect and winterize all materiel before the onset of cold weather.

Whether it is planned to use a piece of equipment in a shelter or in a heated trailer, prepare the materiel to operate at the lowest expected temperatures.

Do not suddenly transfer sighting and fire control materiel from cold to warm or warm to cold temperatures. Condensation induced by this action may cause clouding of optics and rusting of internal parts. Use *anticondensation* containers as prescribed in Section III.

Do not put severe bends in interconnecting cables. All electrical cables should be removed periodically from under accumulated snow. This eliminates locating and digging out cables when preparing to shift the emplacement. Use a cable reel to take up cable when shifting positions, and take care not to allow kinks to form. To prevent heavy equipment from running over interconnecting cables, use stake markers to define the cable paths. Markers also facilitate locating cables for repairs.

### FOGGING OF EYEPIECES

When using optical instruments in severe cold weather, do not breathe on the eyepieces. When warm breath comes in contact with the eyepieces, the moisture in the breath condenses on the lenses and turns to frost. The frost fogs the eyepieces, making observation impossible.

There is no satisfactory antifog solution for use on eyepieces of optical instruments at low temperatures. Some solutions prevent fogging, but they streak the lens, making observation difficult or impossible.

The cold weather mask (Figure 4-2) is the most satisfactory method of keeping breath away from eyepieces. However, a face mask of any type is useful only as long as it directs the breath away from the lens or absorbs the moisture from the breath.

A serviceable face mask can be made from any piece of cloth, woolen scarf, or piece of gauze tied across the face just below the eyes. A mask made from any of these materials not only protects the operator's face from the wind but also deflects the breath from the lens. Change the mask periodically to avoid freezing the face.

When using a range finder, a blanket thrown over the operator and part of the tube increases the time of observation from 2 to 3 minutes to about 20 minutes before the eyepiece fogs. Clean optical surfaces by using tissue lens paper moistened with a few drops of optical lens liquid cleaning compound.

NOTE: Ethyl alcohol can substitute for cleaning compound. If neither lens cleaning compound nor alcohol is available, use dry lens paper. Wrap lens paper around the end of a sliver of wood to make a swab. Dip the swab in optical lens liquid cleaning compound, shake off the excess, and clean lens. Wipe away any compound with lens paper, rubbing from the center outward in a spiral pattern.

**CAUTION**

**NEVER POUR ALCOHOL DIRECTLY ON THE LENS SURFACES, AS EXCESS ALCOHOL WILL INJURE THE LENS SEALING COMPOUND. DO NOT USE ETHYL ALCOHOL NEAR AN OPEN FLAME OR EXCESSIVE HEAT SOURCE.**

**PURGING**

Most sighting and fire control instruments are filled with dry nitrogen to prevent accumulation of moisture inside the instruments. Unit mechanics purge and charge sighting and fire control materiel IAW applicable TMs or when condensation is evident in the instrument.

The gunner's primary sight (GPS) on the M1 series tank has a defroster, which does not automatically shut off after clearing the sight's day window. Excessive heat so generated can crack the window.

**POWERED SYSTEMS**

While some fire control systems use nonpowered devices, most of the newer systems require a power source, either from batteries or external sources. For a full discussion of batteries, refer to Chapter 1 of this manual and to TM 9-6140-200-14.

**Figure 4-2. Cold weather mask**

Some systems require external primary or backup power sources. As temperatures drop, prescribed batteries begin to lose their effectiveness. At lower temperatures, operators may be required to discontinue battery operation and connect the power cable and adapter to a vehicle auxiliary power (slave) receptacle.

Expect temperate zone dry batteries to lose considerable electrical capacity because of decreased chemical activity. These batteries may be used to operate equipment at low temperatures if the internal temperature of every battery is kept high enough to permit normal chemical activity. Dry batteries preheated to approximately 70°F retain sufficient heat for an appreciable period before replacement is necessary. The period of use depends on the rate that heat is conducted away from the battery. It can be extended if the battery is insulated from cold-conducting surfaces by means of nonconductive materials.

When soldiers must carry replacement batteries, they can use the following means to retard heat loss. After preheating, place the batteries in bags lined with kapok or spun-glass fiber materials, wrap in woolen clothing, or carry them close to the body. Under certain conditions, it is advantageous to carry the batteries separate from the equipment by using a connecting cord and plug. This arrangement may require certain modifications to the using equipment to permit installation of the connecting cord and plug. Usually, the modifications are minor and readily accomplished by the using unit.

If replacement batteries can be carried in a vehicle, a well-insulated box that has small heater elements powered from the vehicle battery will ensure maximum usable life of the batteries without heat loss.

**PROTECTION OF TUBE EXTENSIONS AND EYEPIECES**

Snow can collect in uncovered eyepieces and tube sunshades or extensions, rendering instruments useless until the snow is removed. Do not try to blow the snow out of these parts or wipe it out with gloves or bare hands. Some of the particles of snow will melt and freeze on the lenses, causing further difficulty. Use a small, stiff brush or small, rubber bulb with nozzle to remove the snow.

A temporary method of keeping snow out of eyepieces and tube extensions is to put loose wads of tissue lens paper in them when the instrument is not in use. These wads can be removed easily. Care should be taken to prevent the tissues from becoming wet and freezing the tube.

**LEVEL VIALS**

When cold-soaked at temperatures below approximately -40°F, the level vials on sighting and fire control items encounter sluggish movement, elongation of the bubbles, and at times, bubble separation. Sluggish bubble movement and elongated bubbles do not affect the precision of the piece. However, bubble separation does affect accuracy. When bubble separation occurs, briskly rub the top surface of the level vial, and the bubbles will join to become one bubble.

**COMPENSATED SIGHT PICTURE**

For operations in cold regions, mortar gunners must practice firing using the compensated sight picture. This is the rule rather than the exception when firing from frozen surfaces (Figure 4-3).

**LASERS**

The effectiveness of lasers is reduced by rain, snow, clouds, and fog. This is due to the beam being diffused by the water molecules in the air.

**COMPASSES, BINOCULARS, AND OTHER OPTICAL INSTRUMENTS**

The liquid in the lensatic compass thickens in severe cold. The heavy liquid slows the action of the compass and may make it inaccurate. Carry this type of compass near the body in the inner clothing to keep the liquid warm and thin. The dry-type compass is not affected by extreme cold weather.

Cold weather does not affect binoculars and other liquid-free optical instruments. However, condensation does form when instruments are taken from cold air into warm air. Leave instruments outside or use *anticondensation* containers.

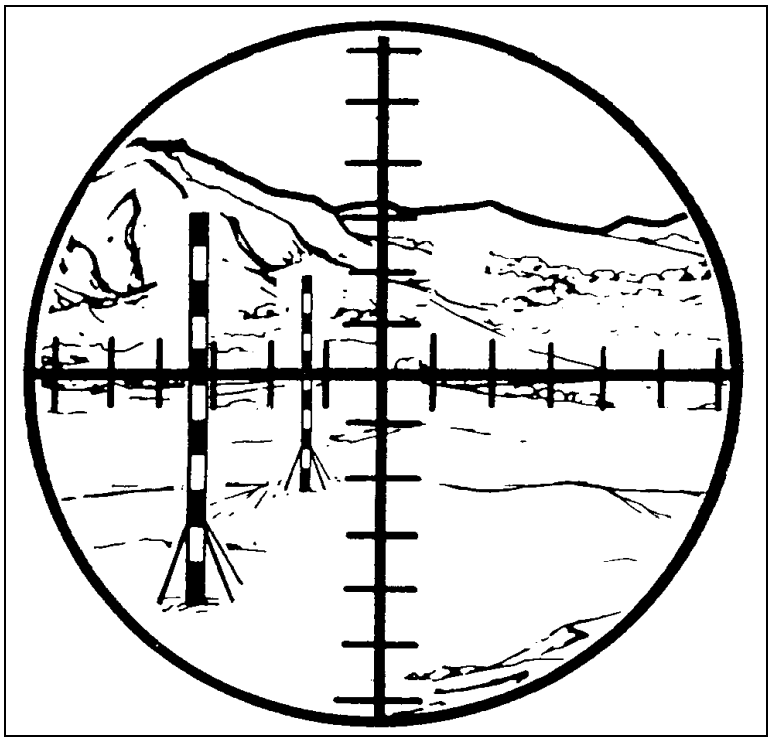

**Figure 4-3. Compensated sight picture**

Cover equipment such as telescopes while not in use. If a cover cannot be made to include the whole instrument, make bag-type cloth covers to go over the eyepieces and tube extensions. Cloth covers are better than airtight covers, such as the leather covers provided for some instruments. The cloth covers allow breathing of the air in contact with the lens. This prevents condensation when the instrument encounters lower temperatures. Cloth bag covers can be made with a spring, elastic, or drawstring at the mouth so they can be held in place and easily/quickly removed.

When temperatures drop, the pressure on the hydraulic accumulator of the independent thermal viewer must be lowered, or its pump will work too hard and wear out quickly. The image transfer assembly also needs attention when the seasons change to preclude excessive purging and desiccant changes. Proper pressures are listed in updated TM 9-2350-259-20.

**DIGITIZED EQUIPMENT**

Liquid crystal displays (LCD) are sometimes affected by extreme cold, causing erratic readings. Do not force switches and knobs on equipment. Thawing may be needed if accumulations of snow or ice have interfered with operations.